

WHAT IS CLAIMED IS:

1 1. A catheter for treating a vascular occlusion comprising:
2 an elongated shaft defined by a proximal section and a distal section
3 wherein the shaft is formed with at least one lumen extending from the proximal
4 section to the distal section of the shaft;
5 at least one hinged spreading member formed at the distal section of the
6 shaft wherein the spreading member is defined by a distal most end that moves
7 away from the longitudinal axis of the shaft to disrupt a vascular occlusion; and
8 an actuating assembly positioned along the elongated shaft to move the
9 distal most end of the spreading member in response to an actuation force.

1 2. The catheter as recited in claim 1, wherein at least one hinged spreading
2 member includes a relatively interior portion formed with a cam follower.

1 3. The catheter as recited in claim 2, wherein the actuating assembly includes
2 an actuation element defined by a distal end and a cam formed at the distal end
3 for communication with the cam follower formed in at least one spreading
4 member to urge the spreading member in a substantially lateral direction.

1 4. The catheter as recited in claim 3, wherein the cam is configured as a
2 central hub that slidably contacts the cam follower formed on the interior portion
3 of at least one hinged spreading member when the cam is moved in a relatively
4 proximal direction to move the distal most end of the spreading member in a
5 substantially lateral direction.

1 5. The catheter as recited in claim 3, wherein the cam is formed with a cam
2 edge that slidably contacts the cam follower formed on the interior portion of at
3 least one hinged spreading member when the cam is moved in a relatively distal
4 direction to move the distal most end of the spreading member in a substantially
5 lateral direction.

1 6. The catheter as recited in claim 3, wherein the distal section of the shaft
2 is formed with a co-linear bearing surface.

1 7. The catheter as recited in claim 6, wherein the cam is configured for
2 slidable movement along the co-linear bearing surface and the cam follower of
3 a single hinged spreading member.

1 8. The catheter as recited in claim 1, wherein the distal section of the
2 elongated shaft contains a nosecone.

1 9. The catheter as recited in claim 1, wherein the distal section of the
2 elongated shaft contains a hub defined by an external surface.

1 10. The catheter as recited in claim 9, further comprising a collar section fitted
2 around the external surface of the hub.

1 11. The catheter as recited in claim 10, wherein at least two hinged spreading
2 members are joined to the collar section as a unitary body.

1 12. The catheter as recited in claim 1, wherein the hinged spreading member
2 is defined by a substantially curved end.

1 13. The catheter as recited in claim 1, wherein the hinged spreading member
2 is defined by a substantially tapered end.

1 14. The catheter as recited in claim 1, wherein the hinged spreading member
2 is defined by a substantially pointed end.

1 15. An intravascular tissue expanding catheter comprising:
2 a catheter shaft defined by a distal end and a longitudinal axis having at
3 least one conduit extending along the longitudinal axis of the catheter shaft;
4 a housing formed at the distal end of the catheter shaft wherein the
5 housing includes at least one hinged deflecting member defined by a distal most
6 tip that moves in a substantially lateral direction away from the longitudinal axis
7 of the shaft to expand vascular tissue; and
8 an actuation assembly positioned along the catheter shaft to move the
9 distal most tip of at least one hinged deflecting member away from the
10 longitudinal axis of the shaft.

1 16. The intravascular catheter as recited in claim 15, wherein the shaft is
2 formed of braided material and an inner coil shaft component.

1 17. The intravascular catheter as recited in claim 15, wherein the housing is
2 formed of deformable material and wherein the actuation assembly includes an
3 expandable balloon formed at the distal end of the catheter shaft positioned within
4 the housing and an inflation conduit formed along the longitudinal axis of the
5 catheter shaft.

1 18. The intravascular catheter as recited in claim 17, wherein the expandable
2 balloon expands to spread open at least one deflecting member so that the distal
3 most tip of the deflecting member moves in a substantially lateral direction away
4 from the longitudinal axis of the catheter shaft.

1 19. The intravascular catheter as recited in claim 15, wherein the deflecting
2 member includes an integrally formed hinge.

1 20. The intravascular catheter as recited in claim 15, wherein the deflecting
2 member includes a hinge that is separately formed and connected to the spreading
3 member.

1 21. The intravascular catheter as recited in claim 15, wherein the deflecting
2 member includes a plurality of hinges.

1 22. The intravascular catheter as recited in claim 15, wherein at least one
2 deflecting member is formed with an internal cam follower.

1 23. The intravascular catheter as recited in claim 22, wherein the actuation
2 assembly includes a cam positioned within the housing for slidable movement
3 along the cam follower of at least one deflecting member to move the distal most
4 tip of the deflecting member in a substantially lateral direction.

1 24. The intravascular catheter as recited in claim 23, wherein the actuation
2 assembly includes an actuation conduit formed along the catheter shaft and a push
3 tube positioned relatively proximal to the cam follower within the actuation
4 conduit.

1 25. The intravascular catheter as recited in claim 23, wherein the actuation
2 assembly includes an actuation conduit formed along the catheter shaft and a
3 rotational tube positioned relatively proximal to the cam follower within the
4 actuation conduit.

1 26. The intravascular catheter as recited in claim 23, wherein the actuation
2 assembly includes an actuation conduit formed along the catheter shaft and a
3 pulling element positioned relatively proximal to the cam follower within the
4 actuation conduit.

1 27. The intravascular catheter as recited in claim 15, wherein the actuation
2 assembly includes a pulling element connected to at least one deflecting member.

1 28. The intravascular catheter as recited in claim 27, wherein the deflecting
2 member is connected to the housing with a hinge pin to form a hinge that
3 supports rotation of at least one deflecting member when the pulling element is
4 pulled in a relatively proximal direction.

1 29. The intravascular catheter as recited in claim 27, wherein the deflecting
2 member and the housing are integrally formed of nitinol to provide a rivetless
3 hinged section that supports deflection of at least one deflecting member when
4 the pulling element is pulled in a relatively proximal direction.

1 30. The intravascular catheter as recited in claim 27, wherein the pulling
2 element is formed of nitinol.

1 31. The intravascular catheter as recited in claim 15, wherein the catheter
2 shaft is defined by an external surface and a guidewire conduit is formed within
3 the external surface of shaft.

1 32. The intravascular catheter as recited in claim 31, wherein the guidewire
2 conduit is formed offset from the longitudinal axis of the shaft.

1 33. The intravascular catheter as recited in claim 15, wherein the catheter
2 shaft is defined by an external surface and a guidewire conduit is formed along
3 the external surface of shaft.

1 34. An intravascular catheter comprising:
2 a catheter body formed with a distal section and at least one conduit;
3 at least one tissue expanding member connected to the distal section of the
4 catheter body wherein the expanding member includes a relatively proximal
5 portion and a relatively distal portion so that the distal portion is configured to
6 spread apart relative to the proximal portion of the expanding member; and
7 an actuation assembly positioned within the catheter body in
8 communication with the tissue expanding member to spread apart the distal
9 portion of the expanding member.

1 35. The intravascular catheter as recited in claim 34, wherein the distal section
2 includes a relatively fixed extension and wherein the relatively proximal portion
3 of the tissue expanding member is connected to the fixed extension with a hinge
4 pin to permit the relatively distal portion of the tissue spreading member to move
5 away from the fixed extension.

1 36. The intravascular catheter as recited in claim 35, wherein the actuation
2 assembly includes an actuation wire connected to the relatively proximal portion
3 of the tissue expanding member with an actuation wire attachment .

1 37. The intravascular catheter as recited in claim 36, wherein the distal section
2 is formed with a guidewire lumen.

1 38. The intravascular catheter as recited in claim 37, wherein the hinge pin is
2 positioned in between the guidewire lumen and the actuation wire attachment
3 within the distal section of the catheter body.

1 39. The intravascular catheter as recited in claim 37, wherein the guidewire
2 lumen is positioned in between the hinge pin and the actuation wire attachment
3 within the distal section of the catheter body.

1 40. The intravascular catheter as recited in claim 39, further comprising a
2 guidewire tube extension defined by an outer surface positioned along at least a
3 portion of the fixed extension for enclosing a guidewire.

1 41. The intravascular catheter as recited in claim 40, wherein the tissue
2 expanding member is formed with a surface that is complementary to the outer
3 surface of the guidewire tube extension.

1 42. A catheter shaft comprising:
2 an outer catheter shaft defined by a longitudinal shaft lumen;
3 an inner coiled body defined by a longitudinal coiled lumen that is
4 positioned within the longitudinal shaft lumen for column load reinforcement of
5 the outer shaft; and
6 a movable pulling element slidably positioned within the longitudinal
7 coiled lumen for relative movement of the pulling element with respect to the
8 inner coiled body.

1 43. The catheter shaft as recited in claim 42, wherein the outer shaft is braid
2 reinforced.

1 44. The catheter shaft as recited in claim 42, wherein the inner coiled body is
2 closely wound.

1 45. The catheter shaft as recited in claim 42, wherein the outer catheter shaft
2 is substantially defined by an outer diameter ranging from approximately 0.025
3 to 0.080 inches.

1 46. The catheter shaft as recited in claim 42, wherein a proximal portion of
2 the inner coiled body is a hypotube.

1 47. A catheter shaft comprising:
2 a reinforced outer catheter shaft formed with an outer shaft lumen;
3 an inner shaft positioned within the outer shaft lumen that is formed with
4 an actuation lumen and at least one inner shaft lumen;
5 a column load reinforcement coil formed with a coil lumen that is
6 positioned within the actuation lumen; and
7 an actuation wire slidably positioned within the coil lumen to provide
8 relative movement of the wire within the coil.

1 48. The catheter shaft as recited in claim 47, wherein at least one inner shaft
2 lumen is configured for placement of a guidewire.

1 49. The catheter shaft as recited in claim 48, further comprising a guidewire
2 positioned within the inner shaft lumen.

1 50. The catheter shaft as recited in claim 49, wherein the inner shaft lumen
2 and the actuation lumen are formed in a non-concentric configuration.
3

1 51. A reinforced catheter body comprising:
2 a braid reinforced catheter shaft formed with a longitudinal catheter shaft
3 lumen;
4 an actuation conduit formed with a longitudinal actuation conduit lumen
5 and a guidewire conduit both positioned within the longitudinal lumen of the
6 catheter shaft;

7 a coiled support tube formed with a coiled tube lumen positioned within
8 the actuation conduit lumen for column load reinforcement of actuation conduit;
9 and
10 a pulling element positioned within the coiled tube lumen for relative
11 slidable movement within the support tube.

1 52. An intravascular catheter for expanding tissue comprising:

2 a catheter body defined by a distal section that is formed with an outer
3 reinforced shaft coaxially formed about an inner coiled body for column load
4 reinforcement of the catheter body wherein the inner coiled body is formed with
5 an actuation conduit;

6 a tissue expanding member defined by an interior cam follower connected
7 to the distal section of the catheter body wherein the expanding member includes
8 a relatively proximal portion and a relatively distal portion so that the distal
9 portion is configured to expand relative to the proximal portion of the expanding
10 member; and

11 an actuation element positioned within the actuation conduit and wherein
12 the actuation element is formed with a cam for communication with the interior
13 cam follower of the tissue expanding member to expand the distal portion of the
14 expanding member when actuated.

1 53. An intravascular catheter for expanding tissue comprising:
2 a catheter body defined by a distal section that is formed with an outer
3 reinforced shaft coaxially formed about an inner coiled body for column load
4 reinforcement of the catheter body wherein the inner coiled body is formed with
5 an actuation conduit;
6 a tissue expanding member connected to the distal section of the catheter
7 body wherein the expanding member includes a relatively proximal portion and
8 a relatively distal portion so that the distal portion is configured to expand relative
9 to the proximal portion of the expanding member; and
10 an actuation element positioned within the actuation conduit to expand the
11 distal portion of the expanding member when actuated.

1 54. The intravascular catheter as recited in claim 53, wherein the distal section
2 of the catheter body includes a relatively fixed extension and wherein the
3 relatively proximal portion of the tissue expanding member is connected to the
4 fixed extension with a hinge pin to permit the relatively distal portion of the tissue
5 spreading member to move away from the fixed extension.

1 55. The intravascular catheter as recited in claim 54, wherein the actuation
2 element is a pull wire connected to the relatively proximal portion of the tissue
3 expanding member with an actuation wire attachment .

1 56. A catheter for treating a vascular occlusion comprising:
2 an elongated shaft having a proximal section and a distal section, a
3 longitudinal axis and at least one lumen extending therein;
4 a tissue displacing assembly having at least one tissue displacing member
5 in the distal section which is configured to rotate about one end thereof away
6 from a longitudinal axis to displace tissue of a vascular occlusion; and
7 an actuating assembly positioned at least in part within the elongated shaft
8 to rotate an end of the tissue expanding member and configured to be operable
9 from the proximal section of the elongated shaft.